GENETIC CORRELATIONS BETWEEN LONGEVITY AND CONFORMATION TRAITS IN DUTCH BLACK AND WHITE DAIRY CATTLE

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Abstract

Genetic correlations between longevity and conformation traits have been estimated using data on Dutch Black and White cows born in 1978 (11,558 records) and 1982 (39,252 records) which had been classified as heifers. Longevity traits considered were: number of lactations, number of days in lactation, herdlife, and stayabilities until 36 and 72 months of age. All traits were also corrected for within herd ranking for first lactation production, and then analyzed. Conformation traits considered were: rear legs set (side view), teat placement, udder depth, suspensory ligament, and overall scores of udder, feet and legs, and type.

Genetic correlations between longevity and conformation traits differed between both years of birth. Of the linear scored traits, only udder depth had significant correlations with functional longevity traits in the 1978 data set. In the 1982 data set, correlations of linear traits were neglectable. In both data sets, overall scores of udder and feet and legs had moderate correlations with longevity traits, being strongest in the 1982 data set. For cows born in 1978, no correlation between longevity and type was found, while for cows born in 1982, this correlation was strong. Main reason for this is that the 1978 population consisted of 82% Dutch Friesian cows, and the 1982 population 26%. Farmers practized large scale Holsteinisation in the period considered, which caused a change in desired type. Estimates of the predictive value of conformation traits for longevity based on data of a population under development might be limited.

1. Introduction

Implementing lifetime performance of cows in a breeding program causes an increase in the generation interval. Alternative traits such as stayabilities until a certain age or productive period can be used, which can be measured earlier but contain less information (Everett *et al.*, 1976). Another alternative might be the use of genetically correlated traits to predict longevity early in a cow's life. Especially within herd level of milk production, and conformation of udder, feet and legs, and overall type seem to have high genetic correlations with longevity (Everett *et al.*, 1976; Rogers *et al.*, 1989; Rogers *et al.*, 1990; Klassen *et al.*, 1992; Luijkx *et al.*, 1992; Short and Lawlor, 1992; Dekkers *et al.*, 1994; Weigel *et al.*, 1995).

Aim of this study is to investigate, for Dutch dairy cows, the genetic relationships between longevity on one hand, and milk production and conformation traits on udder, feet and legs, and type on the other hand.

2. Material and Method

2.1. Material

Lactation records of black and white cows (Dutch Friesian/Holstein Friesian) born in 1978 or 1982 were obtained from the Royal Dutch Cattle Herdbook (NRS). All cows had a complete longevity record. Cows with

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unknown parents were excluded. To reduce computational efforts, data of each year of birth were further edited with each sire having at least 25 daughters, and each herd at least 10 cows. These data sets were matched with conformation trait data. The final data sets consisted of 11,558 and 39,252 records for birth years 1978 and 1982, respectively.

2.2. Traits

The following definitions and abbreviations of longevity, conformation traits, and milk production were used:

LONGEVITY TRAITS:

* number of lactations initiated (NLC);
* total number of days in lactation, summed over lactations (NDL);
* total lifespan (true herd life, THL);
* stayabilities until 36 and 72 months of age (AGE36 and AGE72);

LINEARLY SCORED CONFORMATION TRAITS:

* rear legs set (side view) (RL);
* front teat placement (TP);
* udder depth (UD);
* suspensory ligament (SL);

OVERALL SCORES:

* udder (UDD);
* feet and legs (LEG);
* type (TYP);

MILK PRODUCTION:

* 305-d milk production in first lactation (MILK).

A second set of "functional" longevity traits was considered, with each trait corrected for milk production in first lactation. This correction was performed by a linear regression of first lactation "lactation value" on each trait. "Lactation value" is a net merit index to compare phenotypic performances of cows on a within herd basis for milk, fat, and protein production (standardized for lactation length, season of calving, and age at calving) (Handboek NRS, 1993). Traits corrected for milk production are indicated by the prefix "F": e.g., FNLC, FHL, FAGE72.

Linearly scored conformation traits had values 1 through 9, overall scores values 65 through 89. All cows were classified during first lactation.

2.3. Method

Genetic correlations were estimated using the VCE program by Groeneveld (1993). A siremodel was applied:

$$Y_{ijklm} = herd_i + birthmo_j + HF_k + calvmo_l + sire_m + e_{ijklm}$$

where

Y_{ijklm} = observation on longevity trait, conformation trait, or milk production;
$herd_i$ = fixed effect of herd i;
$birthmo_j$ = fixed effect of the month of birth j;
HF_k = fixed effect of the genetic group k;
$calvmo_l$ = fixed effect of the month of last calving l;
$sire_m$ = random effect of the sire m;
e_{ijklm} = random residual term.

Nine genetic groups were defined according to the percentage of Holstein Friesian genes: 0%, 12.5%, 25%, ... , 100%. If rounding was necessary, this occured towards the breed of the sire. To account for seasonal effects, month of last calving was included in the model. Reasons for seasonal effects could be a desired calving pattern, or culling of cows mainly because a farmer's milk production quota was nearly full. Because the quota year ends on April 1st, it might be that cows are culled in February or March who wouldn't have been culled if the quota was not nearly full (Ducrocq, 1994). The pedigree file contained sire, maternal grandsire, paternal grandsire, and paternal great grandsire, if known.

3. Results and discussion

Table 1 shows the estimated genetic correlations between longevity, and conformation traits and milk production for

Table 1. Estimated genetic correlations between longevity traits, and type traits and milk production (abbreviations explained in text) in dataset 1978.

	NLC	NDL	THL	AGE36	AGE72	FNLC	FNDL	FHL	FAGE36	FAGE72
RL	-.133	-.081	-.104	-.062	-.154	-.243	-.195	-.210	-.136	-.241
TP	-.054	-.038	-.044	-.162	-.092	.082	.095	.083	.067	.041
UD	.060	-.005	.023	-.164	-.067	.438	.351	.385	.348	.235
SL	-.028	-.063	-.060	-.343	-.097	.120	.070	.075	-.129	.040
UDD	.102	.129	.002	.008	.114	.229	.271	.239	.217	.254
LEG	.133	.119	.149	.113	.190	.202	.206	.235	.146	.267
TYP	-.025	.016	.041	-.067	.014	.073	.125	.158	.181	.141
MILK	.449	.511	.476	.735	.474	.090	.181	.130	.202	.165

Table 2. Estimated genetic correlations between longevity traits, and type traits and milk production (abbreviations explained in text) in dataset 1982.

	NLC	NDL	THL	AGE36	AGE72	FNLC	FNDL	FHL	FAGE36	FAGE72
RL	-.047	-.022	-.014	-.006	.024	-.043	-.018	-.012	-.032	.025
TP	.074	.075	.073	-.139	.094	.096	.091	.091	-.146	.125
UD	.031	.007	.015	-.304	.060	.089	.053	.067	-.335	.109
SL	.088	.101	.133	.143	.205	.067	.080	.117	.172	.199
UDD	.310	.326	.329	.098	.344	.353	.365	.369	.148	.389
LEG	.317	.306	.324	.226	.313	.310	.296	.316	.178	.323
TYP	.474	.473	.472	.484	.570	.464	.467	.459	.466	.591
MILK	.387	.472	.441	.799	.361	.331	.435	.390	.840	.301